

Appl. No. 09/787,922
Amendment dated: March 20, 2006
Reply to OA of: June 20, 2005

This listing of claims will replace all prior versions and listings of claims in the application.

Listing of Claims:

1(currently amended). A method of producing a synthetic bone material for use in biomedical applications, said synthetic bone material comprising a macroporous ceramic foam which has an open foam structure containing pores with a modal diameter $d_{\text{mode}} \geq 100 \mu\text{m}$, which method comprises:

(a) forming a ceramic slip comprising a substantially homogeneous mixture of a ceramic particulate, an organic binder in a liquid carrier, and optionally one or more surfactants, wherein at least one surfactant is present if the organic binder does not function as a surfactant, and wherein the ceramic particulate is biocompatible;

(b) foaming the ceramic slip using a ball mill;

(c) heating the foamed ceramic slip at a temperature sufficient to substantially burn out the organic binder;

(d optionally sintering the ceramic foam following burn-out of the organic binder;
and

(e) using the thus produced synthetic bone material in the human or animal body.

2(currently amended). A method as claimed in claim 1, wherein foaming of the ceramic slip is achieved using a ball mill with milling media selected from the group consisting of alumina (Al_2O_3), enstatite (MgSiO_3) [[or]] and zirconia (ZrO_2) balls.

3(canceled).

4(previously presented). A method as claimed in claim 1, wherein foaming of the ceramic slip is achieved using a ball mill in conjunction with gassing and/or a blowing agent.

5(previously presented). A method as claimed in claim 1, wherein the ceramic slip has a viscosity in the range of from 30 to 100 mPas.

6(previously presented). A method as claimed in claim 1, wherein the ceramic particulate is biocompatible.

7(previously presented). A method as claimed in claim 1, wherein the ceramic particulate comprises one or more of hydroxyapatite, a substituted-hydroxyapatite, a glass, an AW-glass ceramic and/or alumina.

8(previously presented). A method as claimed in claim 1, wherein the ceramic particulate has a d_{50} of from 1 to 300 μm .

9(previously presented). A method as claimed in claim 1, wherein the ceramic particulate has a surface area in the range of from 5 to 200 m^2g^{-1} .

10(previously presented). A method as claimed in claim 1, wherein the organic binder comprises one or more of poly (vinyl alcohol), poly (vinyl pyrrolidone), alginate, poly (lactic acid), poly (vinyl butyral), poly (ethylene glycol) and/or poly (vinyl acetate).

11(previously presented). A method as claimed in claim 1, wherein the liquid carrier comprises water, propan-2-ol or trichloroethane.

12(previously presented). A method as claimed in claim 1, wherein the organic binder is present in the liquid carrier in an amount of from 0.2 to 10 w/v%.

13(previously presented). A method as claimed in claim 12, wherein the organic binder is present in the liquid carrier in an amount of from 0.5 to 6 w/v%.

14(previously presented) A method as claimed in claim 1, wherein the ceramic slip comprises from 10 to 95 w/v% ceramic particulate.

15(previously presented). A method as claimed in claim 14, wherein the ceramic slip comprises from 20 to 90 w/v% ceramic particulate.

16(previously presented). A method as claimed in claim 1, wherein the ceramic slip further comprises one or both of a dispersant and/or a defloculant.

17(previously presented). A method as claimed in claim 1, wherein prior to burn-out of the organic binder the liquid carrier is allowed to evaporate from the foamed carrier slip.

18(original). A method as claimed in claim 17, wherein the foamed ceramic slip is heated at a temperature in the range of from 20 to 100°C to facilitate evaporation of the liquid carrier prior to burn-out of the organic binder.

19(previously presented). A method as claimed in claim 17, wherein the concentration of the organic binder in the liquid carrier is selected such that the percentage of binder remaining after substantially all of the liquid carrier has been evaporated is from 0.5 to 10 w/w%.

20(previously presented). A method as claimed in claim 19, wherein the concentration of the organic binder in the liquid carrier is selected such that the

percentage of binder remaining after substantially all of the liquid carrier has been evaporated is in the range of from 1 to 6 w/w%, preferably from 1 to 4 w/w%.

21(previously presented). A method as claimed in claim 1, wherein the foamed ceramic slip is cast in a mould having a surface coated with a release agent.

22(previously presented). A method as claimed in claim 1, wherein burn-out of the organic binder is carried out at a temperature in the range of from 150 to 700°C.

23(previously presented). A method as claimed in claim 1, further comprising sintering the ceramic foam following burn-out of the organic binder.

24(previously presented). A method as claimed in claim 23, wherein sintering is carried out at a temperature in the range of from 500 to 1600°C.

25. (Previously presented). A method as claimed in claim 23, wherein the sintered ceramic foam has a bulk porosity in the range of from 40 to 95%.

26. (Previously presented). A method as claimed in claim 1, wherein the sintered ceramic foam has a strut density in the range of from 60 to 95% of the theoretical density of the ceramic.

27. (Previously presented). A method as claimed in claim 23, wherein the sintered ceramic foam has a modal pore size in the range of from 100 to 2000 µm.

28-31(canceled).

32(previously presented). A method of producing a synthetic bone material as claimed in claim 1, wherein the ceramic slip preferably has a viscosity in the range of from 15 to 200 mPas.

33(previously presented). A method as claimed in claim 8, wherein the ceramic particulate has a d_{50} of from 1 to 15 μm .

34(previously presented). A method as claimed in claim 3, wherein the balls of the milling media have a diameter in the range of from 15 to 25 mm.

35(previously presented). A method as claimed in claim 13, wherein the organic binder is present in the liquid carrier in an amount of from 0.5 to 4 w/v%.

36(previously presented). A method as claimed in claim 15, wherein the ceramic slip comprises from 40 to 80 w/v% ceramic particulate.

37(previously presented). A method as claimed in claim 25, wherein the sintered ceramic foam has a bulk porosity in the range of from 70 to 90%.

38(previously presented). A method as claimed in claim 26, wherein the sintered ceramic foam has a strut density in the range of from 70 to 90% of the theoretical density of the ceramic.

39(previously presented). A method as claimed in claim 27, wherein the sintered ceramic foam has a modal pore size in the range of from 100 to 1000 μm .

40(new). A method of producing a synthetic bone material for use in biomedical applications, said synthetic bone material comprising a macroporous ceramic foam

which has an open foam structure containing pores with a modal diameter $d_{\text{mode}} \geq 100$ μm , which method comprises:

(a) forming a ceramic slip comprising a substantially homogeneous mixture of a ceramic particulate, an organic binder in a liquid carrier, and optionally one or more surfactants, wherein at least one surfactant is present if the organic binder does not function as a surfactant, and wherein the ceramic particulate is biocompatible;

(b) foaming the ceramic slip using a ball mill wherein the balls of the milling media have a diameter in the range of from 10 to 30 mm;

(c) heating the foamed ceramic slip at a temperature sufficient to substantially burn out the organic binder;

(d) optionally sintering the ceramic foam following burn-out of the organic binder;
and

(e) using the thus produced synthetic bone material in the human or animal body.